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ABSTRACT

The extent to which children of two age levels use visual or name codes in recognizing similarities and differences between short words was studied. Subjects were presented with a word for .5, 1.0, or 1.5 seconds, followed immediately by a second word, and were instructed to press a key indicating whether or not the two words had the same name. Word pairs were of three types: physical identity (same word, same case), same name (different case), or different. Older subjects responded more quickly overall and all subjects seemed to rely heavily on visual information at all time intervals. It was suggested that reading experience may influence visual information processing as age increases. (Author)

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Short Term Retention and Recognition of Words by Children Aged Seven and Ten[1]

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It has been suggested that in the rapid recognition of letter stimuli Ss make a transformation from a visual to a name code within a very brief period after presentation of the first stimulus, i.e., the use of visual information to make a match between two linguistic stimuli becomes less efficient over time (Sperling, 1963; Posner, et al, 1969). While it is clear that such transformations take place very rapidly, the conditions under which the use of visual information loses its efficiency are more equivocal (Posner, 1967). The processes or strategies that adults use in recognition tasks vary depending on the nature of the stimuli and other requirements of the task (Sternberg, 1969; Boise, 1969, see Posner, 1969), and little is known about the development of such processing. The present experiment was designed to study recognition processes for word stimuli as a function of exposure time and age of S. The object was to find whether the same principles hold for slightly more complex stimuli such as three letter words and whether children with differing amounts of reading experience handle the task differently.

Method

Subjects. Eighteen students from the Green Acres Elementary School (North Haven, Connecticut) summer recreation program served as Ss in this experiment. The nine Older Ss were aged 10-11 and the nine Younger Ss were aged 7-8. There were approximately equal numbers of males and females in each group.

Stimuli and Procedure. The stimuli were eight three-letter words (e.g., "bet", "run") which were grouped into four pairs. Four sets of words were constructed, each series using different pairs of words. In each set there were

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sixteen test trials, each consisting of a successive presentation of two words. There were three types of trials: (1) physical identity, P, in which the two words were spelled the same and appeared in the same case (lower or upper case); (2) same name, N, in which the words were spelled the same but differed in case; and (3) different, D, in which the words differed in spelling. Half the D words differed in case also. In each set there were four dummy trials which were not analyzed followed by a random sequence of four P, four N, four D1 (same case), and four D2 (different case) stimuli.

There were three exposure times. The first stimulus member on each trial was observed by S for .5 sec., 1.0 sec., or 1.5 sec. prior to the onset of the second stimulus. The dependent variable was S's reaction time in making a "same" or "different" response to the second stimulus. Stimulus list #1 was used as a practice list for all Ss, and each S was presented the list twice, once at 0.5 sec. and once at 1.5 sec. Each S was then presented with the same remaining stimulus sets, one set at each of the exposure times. The order of sets and assignment of sets to exposure times were counter-balanced. At the end of the session Ss were given the reading section of the Wide Range Achievement Test and his reading grade level was estimated. The groups proved to be quite homogeneous and reading level correlated almost perfectly with age. For the younger Ss the range of reading grade-level scores was 1.6-7.5 with a median of 2.7 while for the older Ss the range was 5.0-10.5 with a median of 5.7.

Stimuli were presented by means of a Stowe memory drum. Following the appropriate exposure of the first stimulus word, the raising of the shutter to expose the second word initiated a Hunter Model 1520 electronic counter/timer. S was encouraged to respond as rapidly as possible following exposure of the second stimulus by pressing one of two telegraph keys designated as "same" or "different". S was told to respond "same" whenever the two words had the same name. The "same" key was operated by S's dominant hand. Response latencies

were recorded by E and the timer reset automatically when the memory drum shutter fell.

Results

The data were scored by computing the median reaction time for individual Ss for each experimental condition (Katz and Wicklund, 1971a). Table 1 presents the mean reaction times so computed across Ss for P, N, and D stimulus pairs at each age level and exposure time. Since D1 and D2 times did not differ they were combined for each S. A three-way analysis of variance with a between S factor of Age and whthin S factors of Exposure Time and Type of Pair was applied to the median latency data. There were significant main effects for Age ($F = 4.5$., $df = 1,16$, $p < .05$) and Type of Pair ($F = 7.15$, $df = 2,32$, $p < .04$). The Exposure Time factor did not reach an acceptable level of significence ($F = 1.96$, $df = 2,32$) nor did any of the interactions.

The Age effect is accounted for by the fact that the older Ss respond more rapidly overall than younger Ss. As can be seen in Figure 1, Ss respond more rapidly to Physical Identity pairs than Same Name or Different pairs ($p < .05$, Duncan's New Multiple Range Test, Edwards, 1960) while the latter two do not differ.

Contrary to the findings of Posner, et al. (1969), particularly since this is a 'mixed' list condition (i.e., S may not anticipate the case of the second stimulus), with the present stimuli there does not appear to be a decrease in the utilization of visual information as exposure times increase. If the difference between Name and Physical Identity times may be viewed as reflecting the degree of use of visual information then, if anything, the present data show an increase in such responding. While the difference is not reliable at .5 and 1 sec., sign tests show the physical match to be significantly faster than the name match at 1.5 sec. ($p < .015$). These data are consistent with those of

Exp. PRR-10 where the same stimuli used in the present study were presented to adult Ss and the Name minus Physical Identity differences remained relatively constant across time intervals (.4 to 1.2 sec.).

Discussion

The more rapid responding of the older children was anticipated on the basis of other findings (Hohle, 1967; Katz and Wicklund, 1961b). The maintenance and even increase of the difference between Physical Identity and Same Name matches across increasing time intervals suggests that with stimuli more complex than single letters Ss may use different strategies for holding the information necessary for correct recognition. On the other hand, the substantial Identity - Name difference may be a developmental effect. Although the Age by Type of Pair interaction was not significant, inspection of the data suggests that most of the difference is contributed by the younger Ss. Increased experience with such tasks as reading may influence the ways in which people process visual information, at least of a linguistic type. Young children may hold on to the purely physical information much longer than older children and adults who have had more opportunity and necessity for making transformations to name codes. The obvious need is for a systematic exploration of strategy changes in visual information processing as a function of the linguistic complexity of the stimulus and further elaboration of the developmental aspects of such changes.

Footnote

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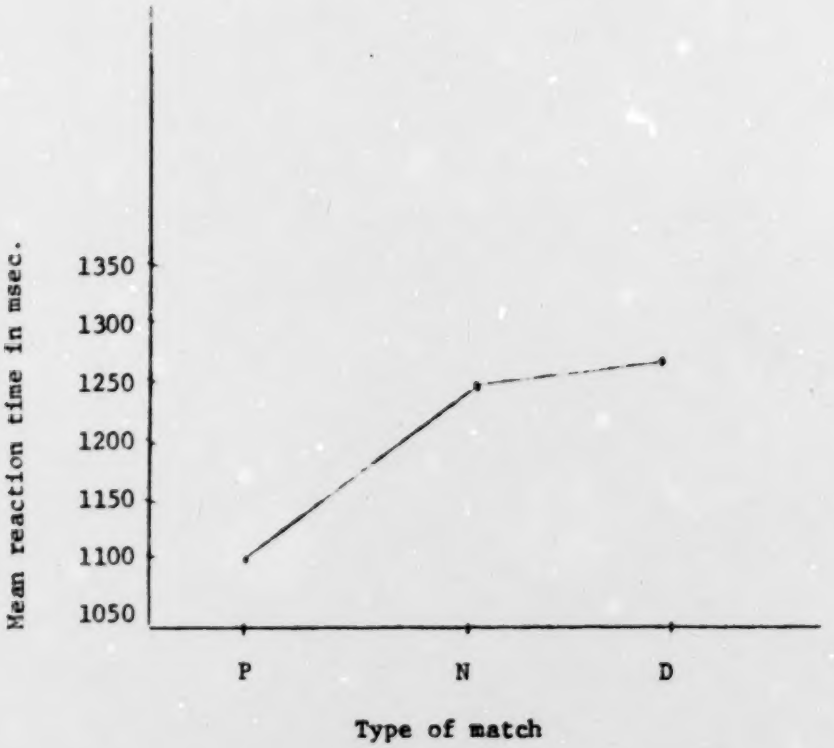
Table 1

Mean reaction times in msec for all experimental conditions.

	Exposure Time in msec	P	N	D	Average
Young (N=9)	500	1328	1449	1432	1403
	1000	1246	1373	1378	1332
	1500	1154	1347	1359	1287
	Average	1243	1390	1390	1341
Old (N-9)	500	1064	1085	1169	1106
	1000	995	1035	1061	1030
	1500	1028	1127	1116	1090
	Average	1029	1082	1115	1075

Figure 1

Mean reaction times in msec. for all Ss for Physical Identity (P), Same Name (N) and Different (D) responses.



The Processing of Visual Information and Its Relation to Response Mode

Of interest here is the time of effective transformation from a visual code to a phonemic code when S is exposed to short words. Posner et al. (1969), using letters, have found that subjects operate wholly on the basis of a phonemic code (or some auditory-linguistic process) after S has observed a single letter for 2 seconds. The present experiment was designed to study the transformation as a function of (1) word exposure time, and (2) response mode, either manual or vocal. It was hypothesized that (a) Ss would utilize visual information more in the brief exposures than in the longer exposures, and (b) Ss would utilize visual information more in the manual response mode than in the vocal response mode, because the latter is a more natural linguistic system. That is, phonemic information should be utilized more readily in vocal responding.

Method

The stimuli were eight three-letter words (e.g., "bet", "run") which were grouped into four pairs. Four sets of words were constructed, each series using a different pair of words. In each set, there were twenty trials each consisting of a successive presentation of two words. There were three types of trials: (1) physical identity, P, in which the two words were spelled the same and appeared in the same case (lower or upper case), (2) same name, N, in which the two words were spelled the same but differed in case, and (3) different, D, in which the two words differed in spelling; half the D words differed in case also. There were five N trials, five P trials and ten D trials in each of the four sets.

There were three exposure times. The first stimulus member of each trial was observed by the S for .4 sec., .8 sec., or 1.2 sec. before the

second stimulus onset. S's reaction time for a 'same' or 'different' response to the second stimulus was the dependent variable of interest. Set #1 was designated as a practice set for all Ss (.8 sec. exposure time was used). Each S was then presented with the three remaining sets, one set at each of the exposure times. Order of sets and times was counterbalanced to give 18 different set-time-order sequences, one for each of the 18 Ss in each response mode group. Ss were randomly assigned to one of two response mode groups, vocal or manual.

Stimuli were presented on a Scientific Prototype 2-channel Tachistoscope. S initiated each trial by pressing the central telegraph key in a three-key board. Eight-tenths of a second later, stimulus 1 was presented for the appropriate length of time and was followed by stimulus 2. After stimulus 2 onset, S made the appropriate response - a key press in the manual mode (where 'same' was the key operated by the dominant hand) and a vocal response into a microphone (held in the dominant hand) in the vocal mode. Response latency was timed by a Hunter Model 1520-Counter/Timer, stopped directly by the keys in the manual mode and stopped by a voice operated relay in the vocal mode. The data of most interest were the differences between responses to N and P stimuli. Since both of these stimuli required the same response (i.e., 'same') in both response modes, the differences between the two modalities in the other physical characteristics of the responses were of no importance.

Results

Table 1 presents mean reaction times (averaged over Ss) for P, N, D1 (same case), and D2 (different case) for each of the three exposure times and each response mode. The times are in the same range as those found by other investigators using manual responding. An analysis of variance with a between-S factor of Response Mode and two within-S factors, Exposure Interval

and Type of Pair (N, P, D) was applied to the data. The data points analyzed were the average of the middle two latencies for each S. (The same analysis was applied to the mean of all five latencies for each condition for each S which produced the same outcome.) The analysis showed significant main effects of Type of Pair ($F = 34.2$, $df = 1/34$, $p < .001$) and Exposure Interval ($F = 10.1$, $df = 2/68$, $p < .001$) but no effect of Response Mode ($F = 2.21$, $df = 1/34$). None of the interactions were significant.

As can be seen in Figure 1, the Exposure Interval effect is accounted for by the steady increase in latency as exposure interval increases. This is a common finding in this type of study. The type of Pair effect derives from the fact that physical matches are consistently faster than name matches, which are essentially the same as Different pairs. The predicted interactions of Exposure Time with Response Mode and Type of Pair failed to occur. Whether S used a vocal or manual response made no difference under any conditions. The failure of the physical match to lose its advantage at the longer time intervals was unexpected but consistent with the findings of Wicklund and Katz (1970) where children were given a similar task with the same stimuli and showed a heavy reliance on physical information at all time intervals.

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Table 1. Mean response latencies in msec. for vocal and manual responding to Physical Identity (P), Same Name (N), and Different (D) pairs of words separated by 0.4 sec., 0.8 sec., and 1.2 sec. (N = 36)

Response Mode	Exposure Time of First Stimulus in Seconds	Type of Pair P	N	D1*	D2*
Vocal	0.4	452	511	502	484
	0.8	482	524	522	511
	1.2	523	545	535	531
Manual	0.4	434	483	515	489
	0.8	451	488	488	497
	1.2	484	518	536	503

* D1 refers to different word, same case (upper or lower); D2 refers to different word, different case.

Figure 1. Reaction time in msec. as a function of exposure time of first stimulus, type of pair (Physical Identity, P, or Same Name, S), and mode of response (Vocal or Manual).